THE EFFECT OF ROOT SYSTEMS OF WILD GROWING AND CULTIVATED PLANTS ON PROTOZOA IN THE SOILS OF UZBEKISTAN

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Information concerning the rhizosphere effect has been obtained and it was discovered that rhizosphere, apart from bacteria, fungi, algae, etc., contains protozoa, and that their population density is higher than is usually met in common practice of soil fauna investigations. Katznelson (1946) was one of the first who discovered during his study of the microflora of fodder beet that protists are much more numerous at beet roots than in the surrounding soil.

A study of soil protozoa on cotton and alfalfa plantations in Uzbekistan (Nikolyuk, 1949) disclosed much greater concentrations of protozoa populations in the rhizosphere than outside of it.

The purpose of investigations was to reveal the significance of vegetation cover, and of root systems in particular, as spheres of the concentration of microorganisms, including the protozoa.

The study of the rhizosphere in their effect on protozoa took place on virgin soils, the soils recently-tilled and long cultivated ones (Nikolyuk, 1965).

Investigations were based upon Berezova's method and carried out on virgin semiarid sandy sierozems of Central Kyzyl-Koum and on light-textured sierozems of the Golodnaya Steppe. The plant association can be characterized on the whole as a sagebrush-saltwort-ephemers community. The following 16 species of the most commonly distributed plants were subjected to a thorough investigation: Aeluropus litoralis, Alhagi sp., Aphanopleura sp., Artemisia herba alba, Bromus danthoniae, Carex pachystylis, Ceratocephalus orthoceras, Halocharis hispida, Limonium gmelinii, Limonium sp., Poa bulbosa, Ranunculus sp., Salsola crassa, S. lanata, S. rigida, Suaeda sp. The results are given in Table 1.

The root systems of wild plants prove to be a potent factor because they accumulate in their rhizosphere a significant population of protozoa.

Table 1

Amount of protozoa (on virgin lands) in the rhizosphere and at a distance from roots, in 1 g of soil

	I	II	III	IV	V	VI	VII	X	XII
Rhizosphere . .	250.0	171.0	126.2	1800.3	783.5	130.7	60.8	85.2	250.5
Flagellates, %	6.9	36.6	66.9	13.5	0.6	3.1	5.9	38.3	13.7
Amoeba, % . .	90.0	59.8	29.1	65.0	67.0	71.0	91.0	51.5	82.0
Ciliates, % . .	3.1	3.6	4.0	21.5	32.4	25.9	3.1	18.2	4.3
Soil devoid of roots	48.8	30.0	2.4	8.2	1.1	3.7	5.5	2.8	20.7

The protozoa population develops mainly in spring. It should be pointed out that in the dry summer seasons and in soils devoid of roots protozoa are practically absent.

Ameoba species were found in considerable quantities, because they are better adapted to the severe dry conditions of these soils. When the soil moisture is high (March, April) the most numerous are flagellates.

The species composition of protozoa confirms that a plant root system is a significant factor in selecting the composition of the protozoa.

The predominant species are: *Bode globosus*, *Oikomonas steini*, *O. rermo*, *Amoeba albida*, *A. gracilis*, *A. limax*, *A. spinfera*, *Colpoda cucullus*, *C. maupasii* and *C. steini*.

Studies of wild plants suggest that there is no strongly pronounced differential selective effect produced by definite species of plants on the protozoa or on some of their groups. However, protozoa develop much more intensively in the rhizosphere of Aeluropus litoralis, Alhagi sp., Carex pachystylis, Poa bulbosa.

The study of the effect of various stages of plant development on protozoa has shown that the protozoa are subjected to an increased effect by the plants during the period of budding and early blossoming.

The effect of cotton root systems on recently cultivated soils and cotton plants grown on old arable land has been studied in light-textured sandy sierozems of the Golodnaya Steppe and in typical sierozems of the Ak-Kawak Agricultural Experimental Station. The results are given in Table 2.

It should be emphasized that the accumulative effect of the cotton root system on protozoa is strongly pronounced.

Already in the first years when cotton was cultivated on ploughed-up virgin soil it became evident that the rhizosphere effect had dropped considerably (Table 3) as compared with the selective effect of root systems of representatives of the wild flora.

Table 2

Amount of protozoa in cultivated soils in the rhizosphere and at a distance from roots, in 1 g of soil (cotton plants)

Site	Soil	V	VI	VII	X
Recently tilled virgin land.	Rhizosphere . . .	6410.0	2590.0	986.0	3560.0
	Devoid of roots	123.7	716.0	366.0	466.0
Long cultivated land.	Rhizosphere . . .	6443.0	3940.0	3520.0	51500.0
	Devoid of roots	900.0	447.0	1265.0	34600.0

It has been noted that with the increase of soil fertility in the course of cultivation there is an increase of protozoa population outside the root system.

The following species are the most frequently met: *Bodo globosus*, *Oikomonas steini*, *O. termo*, *Amoeba albida*, *A. limax*, *Balantiophorus elongatus*, *Colpoda cucullus*, *C. maupasii*, *C. steini* and *Oxytricha pellionella*.

In the course of cultivation the number of species increases and, at the same time, the proportion between those found in the rhizosphere and in the surrounding soil decreases.

In determining the origin of a selective effect of plants and, in particular, of their root systems on the protozoan fauna it has been observed that protozoa and bacteria in the soil are biocoenologically interrelated; protozoa eat bacteria and stimulate their development simultaneously (Table 4).

The study of interrelation between protozoa and different physiological groups of bacteria (Nikolyuk, 1965) has shown that despite their development in the same cultures, however, their interaction with any of these bacterial groups differs substantially. The plant rhizosphere contains much more bacteria than are found in soil devoid of roots.

Table 3

Coefficient of selectivity of the protozoan fauna dependent upon the type of vegetation

Type of vegetation	V	VI	VII	X
Natural vegetation, virgin land	702.0	35.5	10.9	30.3
Cotton on virgin land	52.0	3.6	2.7	7.7
Cotton on long cultivated land	7.1	4.4	2.8	1.5

Table 4

Quantity of microorganisms in rhizosphere soil (in 1 g)

Group of microorganisms	Natural vegetation				Cotton plant stand		
	II	IV	VI	X	V	VI	X
Protozoa . . .	171.0	1800.0	130.7	85.2	6410.0	2590.0	3560.0
Bacteria:							
Ammonifying	$77 \cdot 10^3$	$51 \cdot 10^3$	$10 \cdot 10^3$	$212 \cdot 10^3$	$144 \cdot 10^6$	$842 \cdot 10^3$	$252 \cdot 10^3$
Nitrifying . .	$24 \cdot 10^3$	$42 \cdot 10^3$	$31 \cdot 10^3$	$19 \cdot 10^3$	$150 \cdot 10^3$	$80 \cdot 10^2$	$30 \cdot 10^2$
Denitrifying	$101 \cdot 10^3$	$109 \cdot 10^5$	$313 \cdot 10^4$	$49 \cdot 10^3$	$159 \cdot 10^4$	$80 \cdot 10^2$	$30 \cdot 10^2$
Cellulose decomposing	$47 \cdot 10^3$	$172 \cdot 10^4$	$85 \cdot 10^3$	$23 \cdot 10^3$	$73 \cdot 10^3$	$14 \cdot 10^3$	$28 \cdot 10^3$
Nitrogen-fixing	$73 \cdot 10^3$	$84 \cdot 10^3$	$51 \cdot 10^3$	$29 \cdot 10^3$	$821 \cdot 10^4$	$162 \cdot 10^4$	$251 \cdot 10^3$

Thus, the most favourable conditions for the nourishment of the protozoa exist in the rhizosphere, and the physiological groups of bacteria preferred by protozoa live here in great number.

The main reason for the concentration of the protozoan fauna in the rhizosphere of plants is the accumulation of physiological groups of soil bacteria there which serve as a source of food for the protozoa.

References

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